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Yield Advantages of New Technologies of Chickpea in Rice-Fallow of Indo-Gangetic Plains Zone of West Bengal

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ABSTRACT

Chickpea is the important winter legume crop among all the pulse crops in India. Diversification and intensification of the rice-fallow system by using chickpea has been demonstrated at farmer's field, resulting in adoption by farmer's in some regions. The main driving forces behind the adoption at farm level were cost saving, timely planting and improved system productivity and profitability. In the Gangetic Alluvial Regions (GAR), farmers, encouraged by higher yields of rice and wheat dwarf varieties, intensified their cropping systems, and improved the national crop productivity. Nonetheless, some of areas especially in the eastern parts of Gangetic plains could not take advantage of improved infrastructures like electrical power, groundwater development, irrigation canals, roads and government managed procurement of farm commodities etc. Sowing a second rainfed crop after rainfed rice depends on availability of residual moisture in the soil and provisions of supplementary tube well irrigation. Deficit rainfall or lack of ground water lifting facility results in large areas remaining 'rice-fallow' during the winter season. Recent estimates suggest that 40% of *kharif* rice areas remain fallow in winter either due to lack of irrigation or inappropriate crop establishment methods used for raising a winter season chickpea. This includes approximately 11.65 million ha rice-fallow area in India alone in the states of West Bengal (1.72 m ha). A good combination of agronomic package and practices have been developed but the principal constraint remained the difficulty in establishing a reasonable crop stand once the surface layers of the soil had dried out. There is ample scope of chickpea as a second crop with full packages practices in Gangetic alluvial regions, chickpea favours moderate soil moisture for their growth and development which is available in this soil.

Keywords: Chickpea; Rice fallow; Technologies; Indo-Gangetic Plain Zone; Yield.

Introduction

Chickpea (*Cicer arietinum* L.) is widely grown winter legume crop in India as well as across the Globe. Chickpea is popularly known as Bengal gram or Brown gram or White gram or Kabuli gram. Chickpea is used as different purposes i.e. consumed as leafy vegetable, chana dal, flour (Besan) as well as fodder. Variety of snacks, sweets and dishes can be made out of chickpea flour. Seed contains around 25% proteins and 60% carbohydrates. The desi type of chickpea contributes to around 80% and the Kabuli type around 20% of the total production. India is the largest producer of chickpea contributing to around 70% of the world's total production.

In India, Chickpea production was 7170 thousand tonnes in 2015-16 whereas in 2013-14 it was 9530 thousand tonnes (DES, 2015). Chickpea production also fluctuates year to year because of adverse weather during winter season and recorded a sharp decline over years (Pandey *et al*., 2012). Chickpea (Bengal gram) is a suitable winter pulse crop for farmers to grow on residual soil moisture, i.e. without irrigation, following the harvest of transplanted main season *kharif* paddy in medium to low land situation.

The strategies for cultivation of chickpea under rice fallow have multidimensional techniques for higher production in *rainfed* areas. Approximately 12 million ha of the 40 million ha rice area cultivated during the rainy season remains uncultivated in the post rainy season (Jha *et al.*, 2018). Before sowing of chickpea crop in standing crop is very much crucial for germination of the seed. Soil moisture has to check for proper germination. The rice crop field should be well levelled for maintaining soil moisture in uniform mode in which uniform soil moisture can

obtained, it facilitates uniform germination of seed. The planting geometry of rice crop also plays an important role for higher production of succeeding *paira* chickpea crop. Machine transplanting or line transplanting rice crops gives higher yield itself rather it also gives higher yield of second crop.

During sowing of chickpea it facilitates to germination, proper establishment and minimal disturbance of chickpea crop during harvesting of rice crop (Mahmood *et al*. 2003). In *relay* cropping system land are not prepared only under wet soil seed are sown. In low to medium land soil characterised by clay loam soil with high water holding capacity is suitable for chickpea crop period. The residual soil moisture of this soil is sufficient for chickpea plant growth and development (Hedayetullah and Sadhukhan, 2018).

A good combination of agronomic package and practices have been developed but the principal constraint remained the difficulty in establishing a reasonable crop stand once the surface layers of the soil had dried out. In rice fallow situation chickpea intervention shows as a low-cost compare to other interventions like wheat and potato which is highly profitable crop that can be cultivated without irrigation under residual soil moisture. Well soaked seed is beneficial for ensuring germination percentage of chickpea crop. The seed-priming technology gives better results than non-primed fields (Hedayetullah *et al*., 2017).

Land and tillage preparation

Under normal sowing land preparation is required but relay chickpea cropping system land preparation is not required. Only imbibed seed are sown in standing rice crop with proper soil surface moisture before 10 to 15 days of harvesting. After harvesting of rice, chickpea seedlings already started browsing soil moisture from the deeper layer of soil for its survival. Just after harvest of rice, chickpea seeds are placed with the help of zero till drill machine. The residual soil moisture promotes its growth at early stage and its later stage too. In this process land are not ploughed thoroughly; so primary tillage is avoided and secondary tillage is restricted here. Short duration rice variety generally harvested in the months of October and November.

Sufficient time is available for land preparation with primary tillage implements i.e. country plough, disc plough followed by secondary tillage implements i.e. disc harrow, cultivator, rotavator and planker which takes about 5 to 7 days. In this practice, crop is faced with terminal drought stress and life-saving irrigation is essential to overcome heat stress. Use of high yielding varieties is recommended with appropriate maturity duration. Pusa 372', 'PG 186, JG 315, JG 16, JG 14 and 'Udai' are suitable. Cultivation of early maturing and heat tolerant varieties for eastern India

Judgment of moisture under rice fallow for sowing

Water is limiting factor in harvested rice having soil residual moisture that could sustain a short duration crop. Unfortunately, the surface layers of the soil dry out rapidly so crop establishment is the key objective. Few thumb rules are essential: (1) *Relay/paira/utera* cropping: sowing of chickpea seeds in standing crop 15 days before of harvesting of rice; it ensure germination of seeds where soil moisture is the key factor for its germination (2) Minimum/ zero tillage to cover the seeds (and minimal loss of moisture); (3) Imbibed seed for 4-6 hours in water before surface-drying them to facilitate good germination.

Bio-fertilizers for nitrification and fungicides for disease control

Seed treated before sowing with fungicides followed by rhizobium and trichoderma inoculation for disease free plant and better nodulation. The seed should be treated with fungicides bavistin @ 2 g/kg seed at least seven days before rhizibium and trichoderma inoculation @ 20 g/kg seed with suitable strain. The disease-resistant varieties of chickpea are more suitable to control root rot and blight in *paira* cropping situation. Seed treatment is followed with fungicides Bavistin @ 2 g/kg. Seed inoculated with rhizobium @ 20 g/kg seed for better nodulation. Seed inoculated with rhizobium PSB @ 20 g/kg seed for soil phosphorus solubilization. Seed inoculated with trichoderma @ 20 g/kg seed to control soil born pathogen.

Seed rate and sowing operation

The seed is broadcast at the rate of 100 to 120 kg/ha, 20-25 % higher seed rate of recommended seed rate. To Tillage machines Zero till drill, Seed cum fertilizer drill & minimum tillage etc. Sowing methods generally follow broadcasting and line sowing. Seed priming adopted for better germination. Higher seed rate standardized i.e. 20% more than normal seed rate. Sowing of crop is followed in the month of September to November to avoid soil moisture loss.

Fertilizer management and foliar nutrition

Basal application of fertilizer is not possible under *paira* cropping system. Under nutrient deficient condition nutrient solution like urea and DAP at the rate 2% is foliar sprayed at vegetative stage or before flowering. Foliar spray of urea/DAP to supplement N and P @ 2 % in case of relay/paira/utera cropping is recommended. Machine (Zero till drill, Seed cum fertilizer drill) sowing crop, fertilizers are automatically placed below seed. In conventional sowing, organic manure like farm yard manure @ 5 t/ha are used and inorganic fertilizers (N: P_2O_5: K_2O) used @ 20:40:20 kg/ha. Micronutrient deficiencies are common to alleviate this problem Mo, B, Zn as seed pallets are recommended.

Weed Management

Manual one or two hand weeding is followed at 25 to 30 days or 45 to 50 days after sowing depending upon weed seed bank to control broad spectrum of weed. Pre-emergence like pendimethaline @ 4-5 litre with 400-500 litre of water per hectare. Post-emergence herbicides like Quizalofop ethyl.

Plant protection

To control soil borne pathogen liquid formulation of *trichoderma harzianum* may spray in wet soil. Effective control of all fungal disease can be achieved through seed treatment with *trichoderma harzianum or Pseudomonas fluorescens* @ 20 g/kg seed. Pod borer (*Helicoverpa armigera*) are the serous insect of chickpea. Insect-pests are control through application of pesticides according to types of pest for effectiveness. Mostly pod borer (*Helicoverpa armigera*) at branching and pod development stage is infested more. Pod borer if cross the ETL (Economic threshold level) then Indoxacarb @ 1 ml of litre of water 15 days interval s recommended. Application of Emammectine benzoate 5% SG at the rate of 0.5 g per lit of water twice (one at pre-flowering stage and one at pod development stage) for complete control of gram pod borer.

Management of terminal heat stress

Chickpea heat tolerant line ICCV 92944, while least germination was observed in a heat sensitive line ICC 10685. ICC 5912 and ICC 10685, the two sensitive genotypes, showed the lowest pollen viability. ICC 1205 and ICC 5912 have highest and lowest germination percentages respectively. Residue mulching is effective for other chickpea varieties to avoid terminal heat stress. It facilitates sufficient soil moisture during crop period. Live saving irrigation is beneficial where water is available. Variety like Vaibhav, ICCV-10 and Annigiri also perform well under terminal heat stress.

Mechanization in chickpea

Now a day scientists are more focusing on erect plant type which are easy to harvest by harvester to minimize the cost of cultivation. Use erect type varieties for mechanical harvesting. Tillage machines, for direct seeded planting or row zone placement only. According to land suitability zero-till planter are accepted and harvester for future cultivation of chickpea.

Transfer of technology

Technology is the key factor for higher yield and profit. All the aspect related to the chickpea i.e. MSP (minimum support price), marketing demand, producing quality and particularly variety. Innovative farmer's participatory approach should be like that which are feasible under their environment or location.

Conclusion

It is concluded that from the review study of yield advantages of chickpea using new technologies in Indo-Gangetic plain zone under rice fallow which have ample scope of horizontal expansion of area after harvesting of paddy.

Recommendations

- Use short duration varieties with multiple resistances against major biotic and abiotic constraints like dry rot, pod borer, terminal drought, etc.
- Development of low cost and effective insect pest and disease management strategies.
- Creation and establishment of good numbers of grain processing and value addition facilities of the particular areas. Farmers participatory programme have to be taken up to train and educate farmers about the economic and technical aspects of chickpea production.
- Chickpea production is highly remunerative and less production risks.

Declarations

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Competing Interests Statement

The author declares no competing financial, professional, or personal interests.

Consent for publication

The author declares that he consented to the publication of this research work.

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